# Groundwater Issues In Southeastern Wisconsin

By John Jansen, P.G., Ph.D., Aquifer Science and Technology

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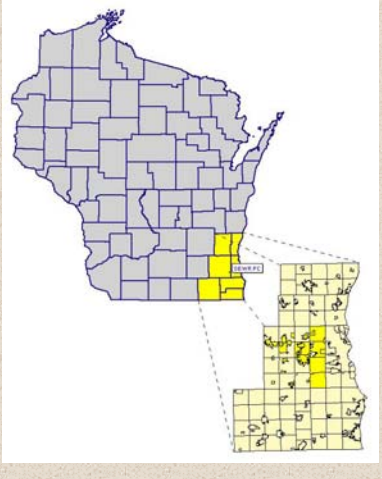
# Southeastern Wisconsin is a small area with a large economic impact

- Approximately 5% of state land mass (2,689 square miles)
- Approximately 36% of the population (1,908,000 in 1998)
- Approximately 36% of all jobs in state
- Approximately 37% of the tangible wealth of the state



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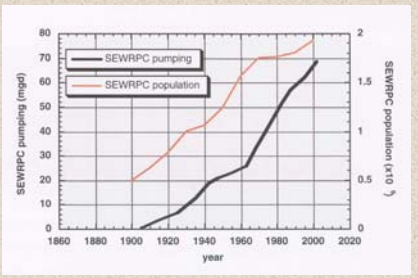
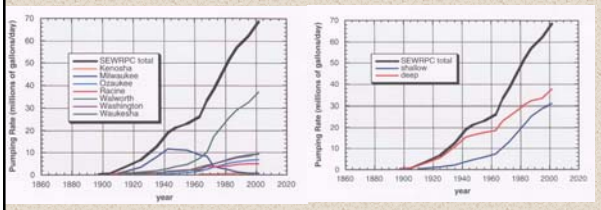
# Water demand rising faster than population growth




- SE Wisconsin water usage up about 40% from 1980 to 2000 while population up about 8%
- Water use slightly higher from sandstone aquifer though mix is changing
- Biggest user in SE Wisconsin is Waukesha County
- SEWRPC 2000 pumpage estimate is about 36 mgd from deep system and 30 mgd from shallow system.
- USGS pumpage estimates 53.5 mgd from shallow system, 54.1 from deep system and 5.4 from combination wells (includes Dodge, Jefferson and Rock counties).

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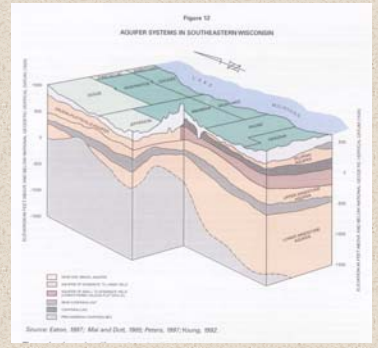
# Major Aquifers in SE Wisconsin....




- Sand and Gravel Aquifer...**near surface sand and gravel deposits throughout much of Wisconsin.**
- Dolomite Aquifer....**Silurian and Devonian limestone and dolomite units in eastern Wisconsin.**
- Sandstone Aquifer....**Cambrian and Ordovician sandstone, dolomite, and shale deposits in southern Wisconsin.**

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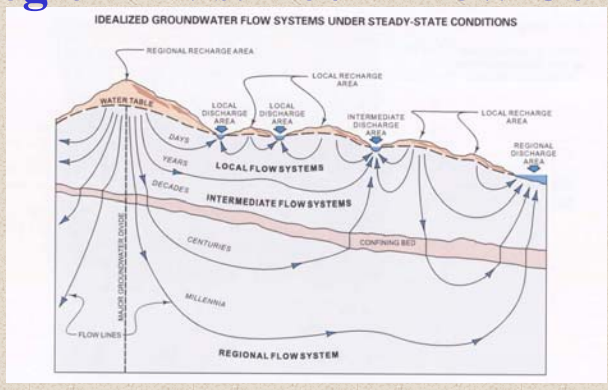
# Regional Vs. Local Flow Cells




- Of the 32 inches of annual precipitation most is lost to evapotranspiration
- A smaller amount run across surface to streams, lakes and wetlands
- A smaller amount (2 to 6 inches)infiltrates to the water table and becomes groundwater
- Most recharge flows through shallow aquifers in local flow cell
- Some recharge flows deeper to sandstone aquifer in regional flow cell

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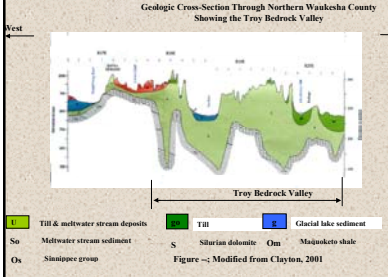
# Sand and Gravel Aquifer Present as Lenses or Channel Deposits In Bedrock Valleys




- Sand not present as uniform layer
- Thickness and permeability of sand changes with location

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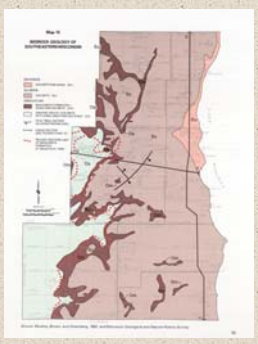
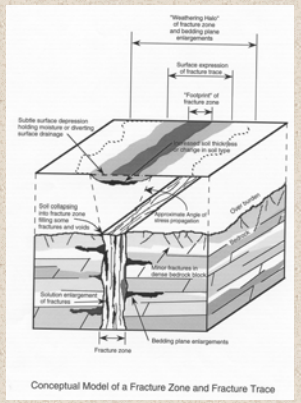
# The Dolomite Aquifer....





Conceptual Model of a Fracture Zone and Fracture Trace

- Silurian dolomite (Niagaran Aquifer) is the regional bedrock for most of eastern Wisconsin.
- Commonly used for private wells
- Used by several municipal water utilities in Waukesha County
- Major permeable zones occur as fracture zones

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# The sandstone aquifer is thick and permeable


- Over 2,000 feet thick
- Wells can pump over 1,000 gpm
- The major aquifer for Waukesha County
- Total pumpage has exceeded recharge for decades
- Water levels are dropping

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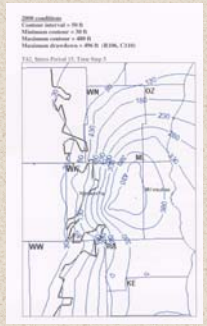
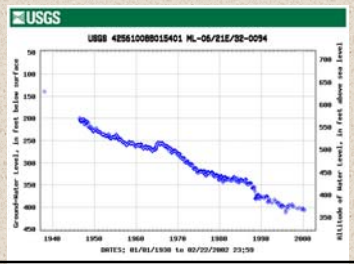
# Over use of the sandstone aquifer of eastern Wisconsin has caused large cones of depression and changes in water quality






- Almost 500 feet of decline since the aquifer was developed.
- In Most of Southeastern Wisconsin head is declining at over 5 feet/year
- Cone reversed flow to Lake Michigan and increased capture of shallow water from west
- Pulling saline water from bottom of aquifer into some wells

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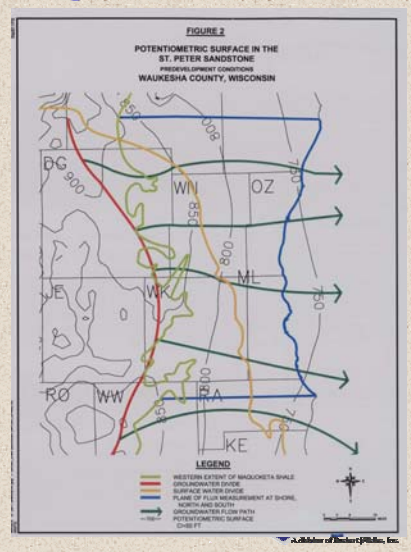
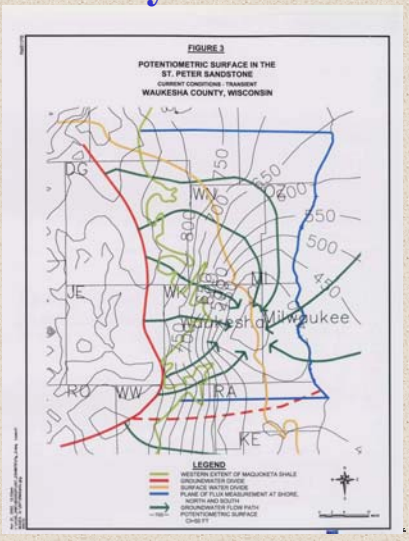
# Sandstone aquifer formerly discharged into Lake Michigan

- Water entered aquifer west of subcontinental divide
- Water flowed upward through shale into shallow aquifers east of subcontinental divide
- Water flowed upward under Lake Michigan into lake
- Original flux was about 2.7 mgd
- Recharge from shallow aquifers west of shale about 0.6 mgd

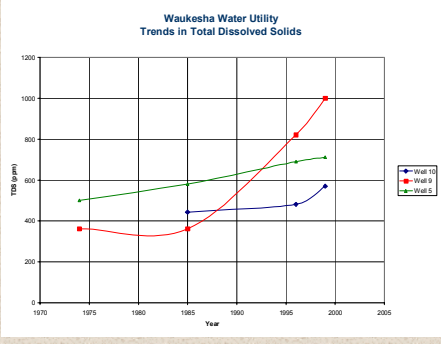


# Heavy pumping has reversed the gradient away from Lake Michigan and captured recharge from Waukesha County

- Water now flows toward pumping center in Waukesha County
- 3 mgd now flows west under shoreline (6 mgd net change)
- 11 mgd downward flow from shallow aquifers through shale into sandstone aquifer (430% increase)
- Divide moved 10 to 20 miles west
- Recharge west of shale has increased to 8 mgd (1350% increase)
- Pumpage in Illinois created a new divide in Racine County




# Mining of Aquifer is Causing Water Quality to Change in Some Wells




- Heavy pumping is causing salinity to rise in some of the deeper wells
- Dewatering part of the sandstone aquifer is causing nuisance bacteria problems
- Continued dewatering may create problems with elevated arsenic similar to Lake Winnebago area

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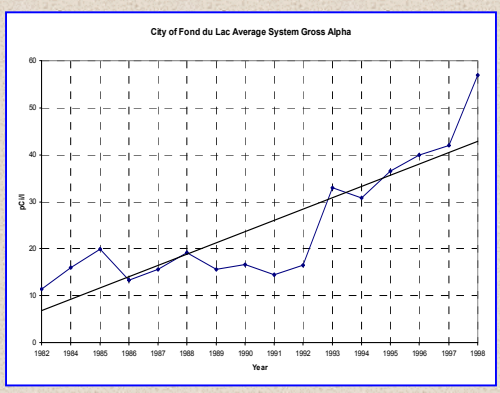
# Radium levels have stayed constant but gross alpha levels may be rising near areas of heavy pumping.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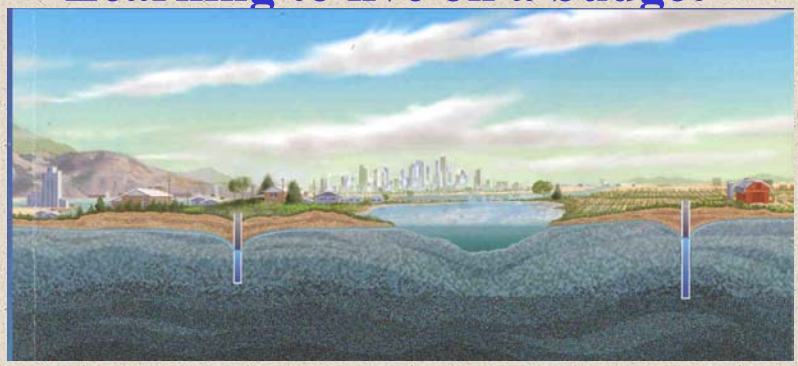
# Learning to live on a budget



- Our water resources are plentiful but finite
- Our annual precipitation determines our water budget
- Our priority uses must include base flow to streams and wetlands
- Deficit pumping will have impacts long before the wells run dry

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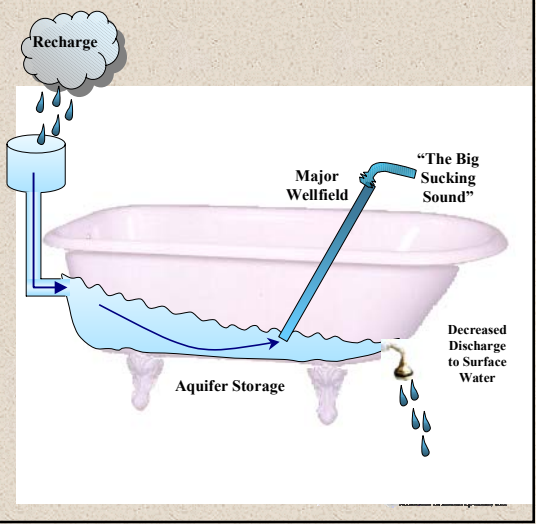
# It is impossible to use a natural resource without impacting it

***Zero impact is not a practical or desirable goal***

- Water intercepted by a well initially reduces storage
- All water pumped from a well ultimately comes primarily from decreased discharge or to a smaller degree from induced recharge
- Shallow aquifers have low storage but higher recharge, mining limited
- Regional confined aquifers have massive storage but low recharge, mining can go on for decades
- Local isolated planning uses the resource inefficiently and misses opportunities for environmental protection




# Most new pumpage will come from the shallow aquifers

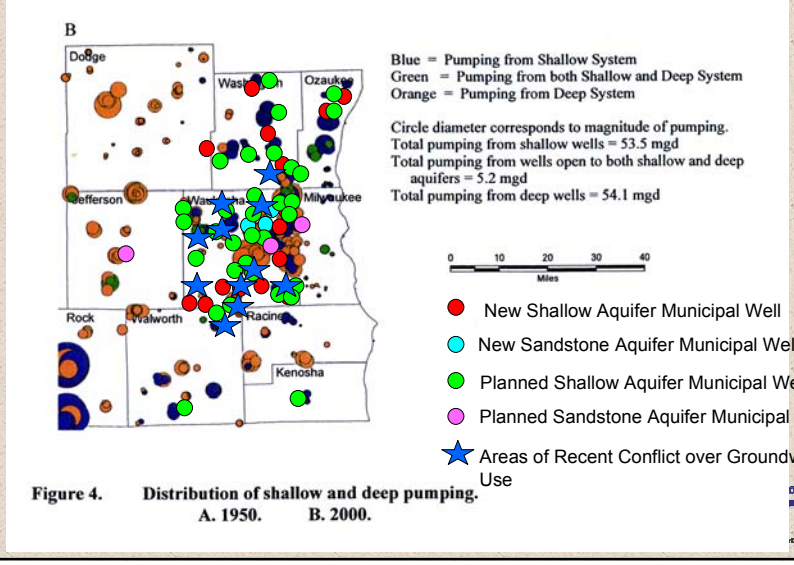
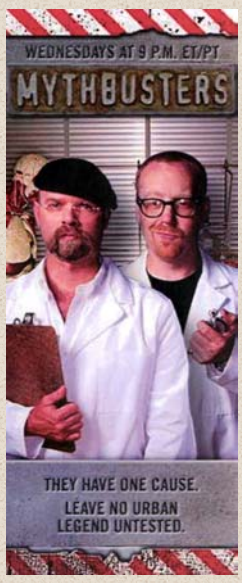



**Figure 4. Distribution of shallow and deep pumping. A. 1950. B. 2000.**




# Time to bust a few myths

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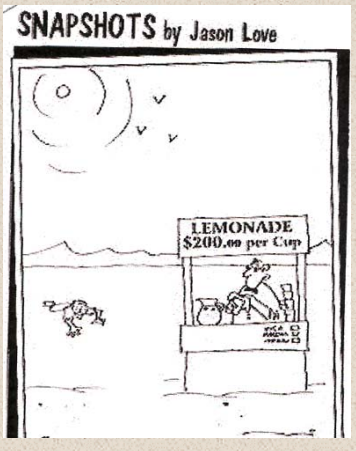
# We are not running out of water!




- Unless the climate changes, we will still get plenty of precipitation
- We can manage our water use more wisely to get greater economic and environmental benefit from the same volume of water
- We don't have to stop pumping the sandstone aquifer
- We don't have to chose between aquatic habitats and people
- In the absence of good planning, the pressure for local Lake Michigan diversions will become intense

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# Pumping the shallow aquifer will not dry up southeastern Wisconsin

- The current pumping from the sandstone is already impacting the surface water and shallow aquifers
- 79% of pumping is coming from decreased discharge and induced recharge from surface water
- Pumpage from the shallow system is only about 9% of average recharge to aquifer
- Done poorly, pumping the shallow aquifers can harm surface water
- Done carefully, additional pumpage can be accommodated without significant harm to the environment

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# If the creator divided us to prevent us from dominating his creation, perhaps he will let us come together to save what's left.

(Samuel Bingham)

## You *can* change the way the world sucks!

**(Anonymous high school student following Sept. 11th)**

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# Stop wasting water!

- Water use is climbing faster than population
- Declining rate block water fees discourage conservation
- Wiser and more efficient use of water is a key to future growth and environmental quality

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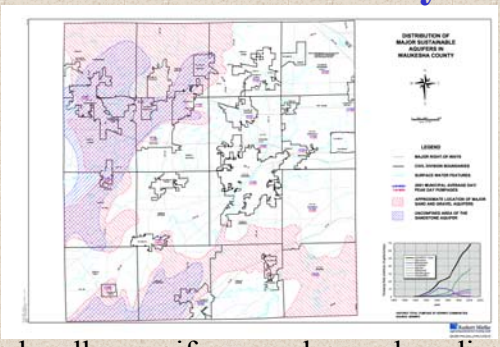
# "Sustainable Aquifers" in Waukesha County



- Major bedrock valley aquifers may have a less direct connection to surface water and may receive recharge from deeper flow systems
- Building rural subdivisions over major shallow aquifers prevents use of critical water sources for the greatest common good
- Unconfined portion of sandstone aquifer receives more recharge, has stable water levels, and better water quality

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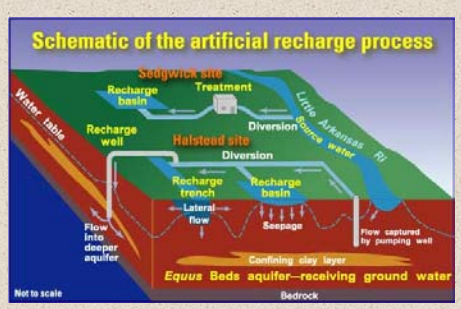
# We waste about 90% of potential recharge




- Most precipitation runs off, is used by plants, or evaporates
- Most runoff comes at high flow periods when it is not really needed
- Increasing recharge component is like getting a raise on our water budget
- Limiting impervious surfaces reduces run off
- Directing run off into infiltration basins increases recharge
- Waste water can be used for recharge under strict controls
- Increasing recharge in sensitive areas can offset pumping impacts

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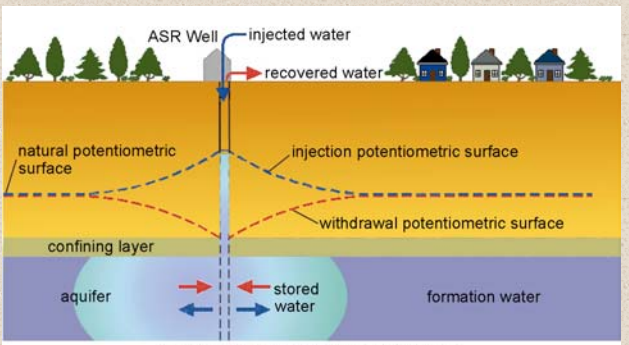
# Shift demand away from shallow system at critical times




*Cross section of a typical ASR system*

- Use sandstone aquifer wells during growing season for wetland communities or during low flow periods
- Use Aquifer Storage and Recovery to store shallow aquifer water during wet times for recovery during dry times

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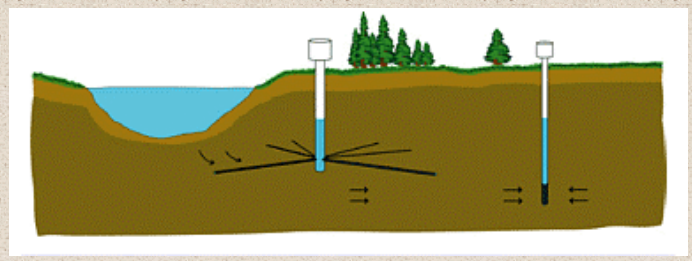
# Take water from the shallow system near the point of discharge



•Waukesha Wells 11 and 12 will pump from shallow aquifer adjacent to Fox River and return flow through treatment plant a short distance upstream
•River Bank Filtration common in Europe and could be used more extensively here to move water to and from receiving bodies in a short flow cell
•Essentially water recycling with natural buffers

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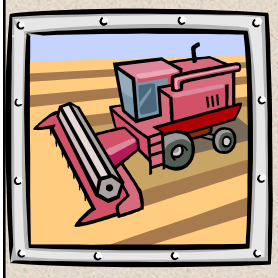
# Lots of things we do can contaminate ground water



**Anything we put on the land can get into ground water**

•Greater use of shallow aquifer increases risk of contamination
•Wellhead protection programs will need to be more effective

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# Hope you picked something up…


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